Plant Life Extension in Central Europe – relevant UK experience

Peter Handley
- National Laboratory for both UK Government and Industry
- Support to national R&D programmes
- Host and lead NIRO
NNL – Facts & Figures

• Around 800 staff
  - Over 60% of whom have science or engineering degrees / PhDs

• Key customers
  – Sellafield Ltd, EdF Energy, NDA, Magnox, MoD, Westinghouse, UK Government, Regulators

• Annual turnover of around £86M

• Profit of around £9.5M – re-invested in R&D and Capital schemes

• Operating as a commercial business
  - No direct funding grant from HMG
NNL supports all nuclear programmes

• Continued operation of existing reactors & fuel cycle facilities (fuel fabrication, reprocessing)
• Legacy waste management / decommissioning
• New nuclear build
• Geological disposal
• Plutonium stockpile disposition
• Naval propulsion support
• Advanced reactor & fuel cycles
• Space propulsion systems
• Security, non-proliferation & safeguards
The Role of the National Nuclear Laboratory

Universities

- Basic Science
  - Proof of principle
  - Small scale
  - Low radiation
  - Surrogate materials
  - Non-licensed

NNL

- Research, Development and Testing
  - Convert why (science) to how (technology)
  - Independent and authoritative
  - Establish practicality
  - Scale up
  - Actual materials
  - Licensed facilities

Industry

- Technology Deployment
  - Application of product
  - Full scale
  - Solution to problem
  - Marketable

Technology maturity
Plant Life Extension – a case study

Huw Morgan
Director,
Critical Plant items - HA
Evaporators

• Three HA Evaporators – built in the 1970s

• Critical link in converting liquor from fuel reprocessing into vitrified waste product.

• Needed to validate safe operation against known programme lifetime (a new evaporator is > £500M and 5 years!)

• Challenge was to:
  • undertake inspection
  • Understand material condition
  • Model corrosion processes
  • Develop predictive lifetime model
Technology to be applied

- Inspect internal coils of HA evaporator for determination of Lifetime extension – CCTV and Ultrasound

- Innovative - designed to meet the following criteria;
  - Radiation tolerant
  - Remote deployment – no human access
  - Inspection up to 45 m from insertion point
  - Robust/recoverable (ie dissolvable)
  - Inspect every 5 mm around internal circumference
  - Automated

Liquor level (approx)
½”
Results

- In service cell inspections visually assessed the external condition of the HA evaporator components.

- Ultrasonic coil inspection corrosion and thickness measurements determined the condition of the evaporator components.

- Routine ultrasonic inspections identified corrosion loss;
  - Increased with submerged depth
  - And with each fuel type processed

- Extrapolation of the coil inspection data is used in structural and thermal Finite Element Analysis, statistical analysis and the assessment of uninspected components.

- The condition and remnant life assessments of the evaporators can now be determined.

Ultrasonic Thickness Measurements
Benefits

• Significant improvements made to evaporator operations to increase plant life.

• Stress ranges for the various load cycles have been generated using Finite Element Analysis.

• Remaining fatigue life of the evaporator estimated for a range of operational options.

• Improved coil heating and cooling management implemented.

• Substantiation for additional evaporator capacity.

• New evaporator construction optimised to reduce costs and meet the requirements of reprocessing, POCO and decommissioning.
Plant Life Extension – What can the UK offer

Huw Morgan
Director,
UK experience in PLEX

- **Magnox**
  - Design lives extended from 25 years to 42 years
    - Pressure vessel embrittlement
    - Boiler corrosion
    - Graphite

- **AGR**
  - Average 7-year life extensions to all plants
    - Structural re-validation
    - Boiler corrosion
    - Fuel failures
    - Graphite

- **Sizewell PWR**
  - 20-year life extension to 60 years

- **Chemical Reprocessing/Waste Plants**
  - Remote inspection
  - Corrosion
  - Fatigue/stress corrosion cracking

- **Naval Reactors**
PLEX, - What can the UK offer

- Current experience in assessment against a modern Regulatory regime
- Reactor and station plant chemistry (primary side, storage (incl ponds) and associated plant), technical governance support for plant.
- Materials performance assessment (steels and Zr alloys including embrittlement and irradiation issues)
- Modelling (reactor chemistry/corrosion)
- Peer review of plant data and reviewing technical standards/documents
- Ageing plant strategy management
- Plant Inspection regimes
- Fuel cycle extension programmes (eg 24 months compared to 18 month fuel cycle and its impact on the plant)
- International guideline implementation
- Obsolete instrumentation evaluation/verification/re-qualification
- Irradiated fuel and component assessment
- Emergency Management (advice to Government on Emergency Scenarios, eg Fukushima)